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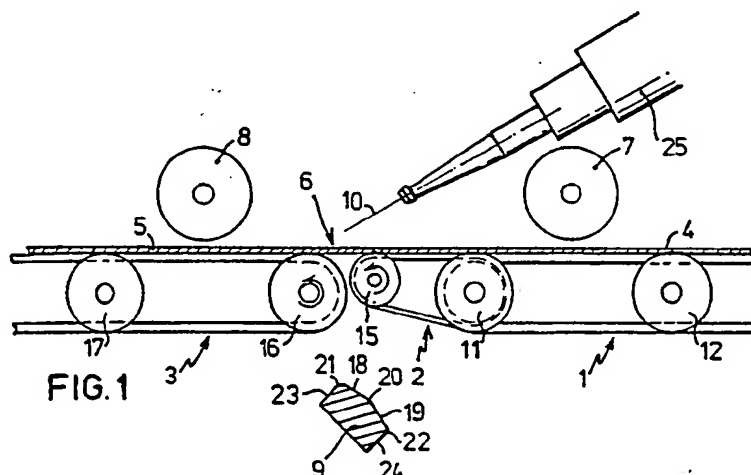
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⑤ A cutting device for cutting a strip of unvulcanized rubber.

⑦ A cutting device for cutting strips of unvulcanized rubber to proper lengths for building a pneumatic tyre, in particular a radial tyre, said device comprising at least one conveyor and a cutting apparatus working crosswise with respect to said conveyor for cutting a strip of unvulcanized rubber, wherein said apparatus for cutting said strip comprises means to vibrate a knife longitudinally to and fro with high frequency e.g. ultrasonic frequency and means to move the knife vibrating longitudinally to and fro along a track crosswise with respect to said strip.



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## A cutting device for cutting a strip of unvulcanized rubber.

The invention relates to a cutting device for cutting strips of unvulcanized rubber to proper lengths for building a pneumatic tyre, in particular a radial tyre, said device comprising a conveyor and a cutting apparatus working crosswise with respect to said conveyor for cutting a strip of unvulcanized rubber.

Each radial pneumatic tyre consists of a carcass with at the inside at least one air-tight layer to provide that the air pumped into the tyre not escapes. Furthermore, strips are applied on said carcass to form the sidewalls of said tyre and also strips are applied to form chafers to protect the beads of said tyre. Also a strip of white rubber mixture with a covering strip thereon in a thick strip forming a sidewall of said tyre can be applied, and after vulcanizing the covering strip is grinded, so that a white decoration strip decorates the completed tyre.

All these strips should each be cut off from a long strip shaped supply into a proper length, that the ends of each strips situated on a building drum of a tyre building machine join each other. With all above mentioned types of strip shaped material said joining is necessary to make the tyre as homogeneous as possible, so that said tyre rolls uniformly and is uniformly strong, which is only possible if each strip at its splice shows no slit with the joint between its both ends. Such a slit in the above mentioned white strip is moreover disadvantageously, because in situ of the slit the white strip is interrupted and marred by black smudges. Besides, said joining is particularly necessary for constructing the above mentioned air-tight layer in order to splice the ends of the strip or strips in an air-tight way to each other over their complete width.

It is known to cut said strips in proper lengths along an oblique cutting line by means of cutting or sawing discs rotating at high speed or by hot knives which are pulled through each strip at low speed. The friction between the unvulcanized rubber and the cutting or sawing discs is reduced by moistening these discs with high-grade alcohol, but high-grade alcohol is expensive and is consumed rapidly. With hot knives the temperature should be adjusted very accurately, because with a too hot knife the knife becomes dirty and/or vulcanizes the unvulcanized rubber which comes into contact with said knife, while with a too cold knife the cut in the unvulcanized rubber is rough and irregular. However, keeping the knives accurately at the right temperature appeared to be hardly possible in practice.

According to the present invention above dis-

advantages of the known installations can be removed in that the apparatus for cutting the strip comprises means for vibrating a knife longitudinally to and fro with high frequency e.g. ultrasonic frequency and means to move said knife along a track crosswise with respect to said strip.

Indeed the application of the knives vibrated to and fro with high frequency along their length are known per se for cutting thick film of synthetic material, but application in practice showed that this type of knives does not produce the desired result with unvulcanized rubber in that among others the fresh cut rubber elements adhere again to each other. Moreover, the known installations are not suitable for the application of this type of knives.

That is why the invented device preferably is characterized by means for clamping the strip against conveyors at both sides of the cut to be produced and by means for subsequently stretching the clamped portion of said strip during cutting, said strip being put back in condition for conveying by the conveyor by removing the clamping after the strip has been cut to the proper length.

As a result of this the cut surfaces of unvulcanized rubber are immediately pulled away from each other after the cutting, so that adhesion of said cutting surfaces to one another is not possible.

Some other characteristics of possible embodiments of the invented device are indicated in the enclosed sub claims from claim 3.

These and other advantages and characteristics of the invention will be further described in the following description of an embodiment of the invented device and wherein it is referred to the enclosed drawings. It will be apparent that the invention is not restricted to the described embodiment as shown in the drawings, because said embodiment is only an example. In the drawing is:

figure 1 a schematical side view of the invented device in the conveying condition.

Figure 2 a side view as in figure 1 but the device is in the cutting condition.

Figure 3 a schematically indication of the phases of the work cyclus of the device according to figure 1.

Figure 4 a schematical top view of the device according to figure 1.

The invented device comprises according to figure 1 in principle a supply conveyor 1, an intermediate conveyor 2 and a discharge conveyor 3. The phases of the work cyclus of the invented device are shown in figure 3. In phase I a strip 4 of unvulcanized rubber is conveyed from a storing

reel (not shown) over these three conveyors from the right to the left. As soon as a piece 5 of strip with the desired length is situated with its rear end 6 above the intermediate conveyor 2, all conveyors are stopped. Subsequently in phase II in figure 3 a clamping roller 7 cooperating with the supply conveyor 1 is moved downwardly from the position shown in figure 1 to the position shown in figure 2, as a result of which the strip 4 is forced against the supply conveyor 1 and thereby it cannot be moved forward any more. Simultaneously also in phase II in figure 3 a clamping roller 8 cooperating with the discharge conveyor 3 is moved downwardly from the position shown in figure 1 to the position shown in figure 2, as a result of which the piece strip 5 is forced against the discharge conveyor 3 and is not movable any more.

Subsequently, in phase III shown in figure 3 the intermediate conveyor 2 is pivoted downwardly from the position shown in figure 1 to the position shown in figure 2. After that, in phase IV shown in figure 3 a cutting beam 9 is moved upwardly from the position according to figure 1 to the position shown in figure 2. In the position shown in figure 2 the top of the cutting beam 9 lies higher than the upper courses of the conveyors 1 and 2, so that the rubber strip 4 of rubber is stretched as on the one hand the strip is clamped between the clamping roller 7 and the supply conveyor 1 and on the other hand between the clamping roller 8 and the discharge conveyor 3.

Subsequently the above, in phase V shown in figure 3 the knife 10 is moved crosswise with respect to the strip 4 and simultaneously the knife is vibrated longitudinally to and fro with high frequency, e.g. ultrasonic frequency. After the strip 4 has been cut, the cutting beam 9 is moved downwardly in phase VI shown in figure 3 from the position shown in figure 2 to the position shown in figure 1.

Subsequently, in phase VII shown in figure 3 the intermediate conveyor 2 is moved upwardly from the position shown in figure 2 to the position shown in figure 1 to fill up the gap between the supply conveyor 1 and the discharge conveyor 3 as much as possible. Finally, in phase VIII shown in figure 3 the clamping rollers 7 and 8 are moved upwardly from the position shown in figure 2 to the position shown in figure 1, so that the strip 4 and the length 5 cut off from the strip are free with respect to the clamping rollers. After that first the cut off length 5 is discharged to the building drum for pneumatic tyres (not shown) by means of the discharge conveyor 3 for further processing, and subsequently the strip 4 is supplied further from a storing reel (not shown) to the discharge conveyor 3 by means of the supply conveyor 1 via the intermediate conveyor 2 in the phase I shown in

figure 3, after which the remaining, above described phases shown in figure 3 can be executed again. The storing reel and the building drum are not shown in the drawings and not described here, because they are known.

It will be apparent that the supply conveyor 1 shown in figure 1 comprises a reversing roller 11 and a supporting roller 12 and where preferably, as shown in figure 4, endless strings 13 run over these rollers. Besides, these endless strings run over supporting rollers situated outwardly from figure 1 and 4 and a driven, second reversing roller. Said strings are from elastic material which moreover can be resiliently.

The reversing roller 11 and the supporting roller 2 are rotatably secured in a frame 14 as shown in figure 4 and are situated close to each other in such a way that when the clamping roller 7 (figure 2) has been moved into a downward position a strip 4 of unvulcanized rubber on the strings 13 is sufficiently clamped between the strings 13 and the clamping roller in its downward position as shown in figure 2. The means for moving the clamping roller 7 (figure 1 and 2) downwardly and upwardly again are not indicated in the drawings and also not discussed, because for this movement means are used which are obvious for an expert.

Preferably the one reversing roller of the intermediate conveyor 2 is at the same time the reversing roller 11 of the supply conveyor 1 as shown in figure 2. Endless strings run over said reversing roller 11 and also over the other reversing roller 15 of the intermediate conveyor 2. The means for pivoting the intermediate conveyor 2 about the axis of the reversing roller 11 downwardly and upwardly again (figure 1 and 2) are neither indicated in the drawings nor discussed, because these means are obvious for experts.

Also the discharge conveyor 3 shown in figure 1 comprises a reversing roller 16 and a supporting roller 17, where e.g. endless strings 13 run over said rollers as shown in figure 4.

These endless strings run moreover over supporting rollers and a driven, second reversing roller, all these rollers being situated outwardly from figure 1 and 4. The reversing roller 16 and the supporting roller 17 are rotatably secured in a frame 14 as shown in figure 4 and are situated close to each other in such a way that when a clamping roller 8 (figure 2) has been moved into a downward position the piece 5 of the strip of unvulcanized rubber on the strings 13 is sufficiently clamped between the strings 13 and clamping roller 8 moved downwardly as shown in figure 2. The means for moving the clamping roller 8 (figure 1 and 2) downwardly and upwardly again are neither indicated in the drawings nor discussed, because for this means may be used which are obvious for

an expert.

The cutting beam 9 is preferably made of Teflon and the upper side of the cutting beam shown in figure 1 is composed of two cross-sectionally sloping surfaces 18 and 19 which join each other via a rounded off surface 20. Each sloping surface 18 and 19 is joined via a rounded off surface 21, 22 respectively to a side 23, 24 respectively of the cutting beam. The rounding off 21 is such that the knife 10 can be positioned with an angle between 10 and 90 degrees with respect to the strip 4 of unvulcanized rubber while the knife blade bears on the cutting beam. The means for moving the cutting beam 9 (figure 1 and 2) upwardly and downwardly again are neither indicated in the drawings nor discussed, because for this means may be used which are obvious for an expert.

The apparatus 25 for vibrating the knife 10 with high frequency, e.g. ultrasonic frequency, longitudinally to and fro (consequently in the plane of the drawings) is only schematically indicated in figure 1 and 2 and is not discussed further, because such an apparatus is known per se for cutting film of synthetic material. Means for moving the apparatus 25 with the knife 10 from the right to the left and back over the width of the strip 4 in figure 4 are neither indicated in the drawings nor discussed, because for this movement means may be used which are obvious for an expert.

It is important that the knife 10 with the drive apparatus 25 is pivotably mounted such, that the knife in the strip 4 of unvulcanized rubber can make a cut with an angle of inclination, which can be selected between 10 and 90 degrees with respect to the length of the strip. Also these pivotable securing means for the drive apparatus 25 are neither indicated in the drawings nor discussed, because for this means may be used which are obvious for an expert.

It is also important that the free, pointed end of the knife 10 is free and remains free with respect to the cutting beam 9 and also that it does not contact with other members, but the knife blade should bear on the cutting beam.

By clamping the strip 4 of unvulcanized rubber between the clamping rollers 7 and 8 and the supply conveyor 1, the discharge conveyor 3 respectively it is prevented that the strip can move, because when it moves irregular cuts are the result.

The cutting beam 9 moved upwardly as shown in figure 2 stretches the strip 4, resulting in that the cut surfaces facing each other move away from each other immediately on the movement of being cut by the knife 10. The result is that the adhesion to each other of cut surfaces of unvulcanized rubber is prevented.

Besides, the strip 4 is supported by the cutting beam 9 with as a result that a cut without irregularities is produced in the strip.

Finally, the conveyor 2 in its normal position as shown in figure 1 causes a non disturbed conveyance of the strip 4 from the supply conveyor 1 to the discharge conveyor 3.

Because the knife according to the invention is vibrated with high frequency, e.g. ultrasonic frequency, longitudinally to and fro, it is avoided that the knife has to be kept moistened with high-grade alcohol, which is consumed rapidly and therefore should be applied in large quantities in known cutting machines with fastly rotating cutting discs or sawing discs. Using large quantities of high-grade alcohol for reducing the friction between unvulcanized rubber and cutting discs or sawing discs is therefore expensive and is consequently avoided by the invention. Also heating of the knife is avoided according to the invention, because a too hot knife causes vulcanisation of unvulcanized rubber at the cut and/or contamination of the knife, while a too cold knife causes an irregular cut. Keeping the knife constantly at the right temperature has appeared to be hardly possible in practice, so that the invention offers a solution for this problem.

Besides, the invented device is completely adjusted to the knife vibrating to and fro with high frequency. That is why the time necessary for realising a cut is less than the time necessary for building a pneumatic tyre. Furthermore, the invention construction makes the optimum use of a knife vibrating to and fro with high frequency possible. Finally, by clamping the strip by means of the clamping rollers during cutting and by stretching the strip by means of the cutting beam during cutting, the fresh cut faces of unvulcanized rubber do not have the opportunity of adhere to each other. Besides, the strip is supported by the cutting beam during cutting with a result that the cut is regular. Finally, the strip is well conveyable from the supply conveyor to the discharge conveyor by means of the intermediate conveyor.

## Claims

1. A cutting device for cutting strips of unvulcanized rubber to proper lengths for building a pneumatic tyre, in particular a radial tyre, said device comprising at least one conveyor and a cutting apparatus working crosswise with respect to said conveyor for cutting a strip of unvulcanized rubber, characterized in that said apparatus for cutting said strip comprises means to vibrate a knife longitudinally to and fro with high frequency

e.g. ultrasonic frequency and means to move the knife vibrating longitudinally to and fro along a track crosswise with respect to said strip.

2. A cutting device according to claim 1, **characterized by** means for clamping said strip against the conveyors at both sides of the desired cut and by means for subsequently stretching the clamped portion of the strip during cutting, said strip being put back in condition for conveying by the conveyor by removing the clamping after the strip has been cut to the proper length.

3. A cutting device according to claims 1 or 2, **characterized by** an intermediate conveyor between a supply conveyor and a discharge conveyor, said intermediate conveyor being pivotable in order to make room for a cutting beam, said cutting beam being movable upwardly from a retired position into a position wherein it pushes a strip of unvulcanized rubber upwardly out of its normal position during cutting the strip and the cutting beam after the cutting operation being movable downwardly to the retired position to make room for said intermediate conveyor.

4. A cutting device according to claims 2 or 3, **characterized in that** each conveyor comprises an endless carrier element for the strip to be conveyed, wherein the carrier element extends over a reversing roller situated near said intermediate conveyor and over a supporting roller, each of the clamping means comprising a clamping member which is movable by the clamping means from a position releasing the carrier element with the strip thereon downwardly into a position for pushing the carrier element with the strip downwardly, the reversing roller, the clamping member and the supporting roller being situated at a sufficient distance from each other to clamp the strip on the carrier element in the downwardly pushed position of the clamping member, wherein the clamping member is movable upwardly again from said clamping position to the releasing position by means of said clamping means.

5. A cutting device according to claim 4, **characterized in that** each carrier consists of a series of endless strings.

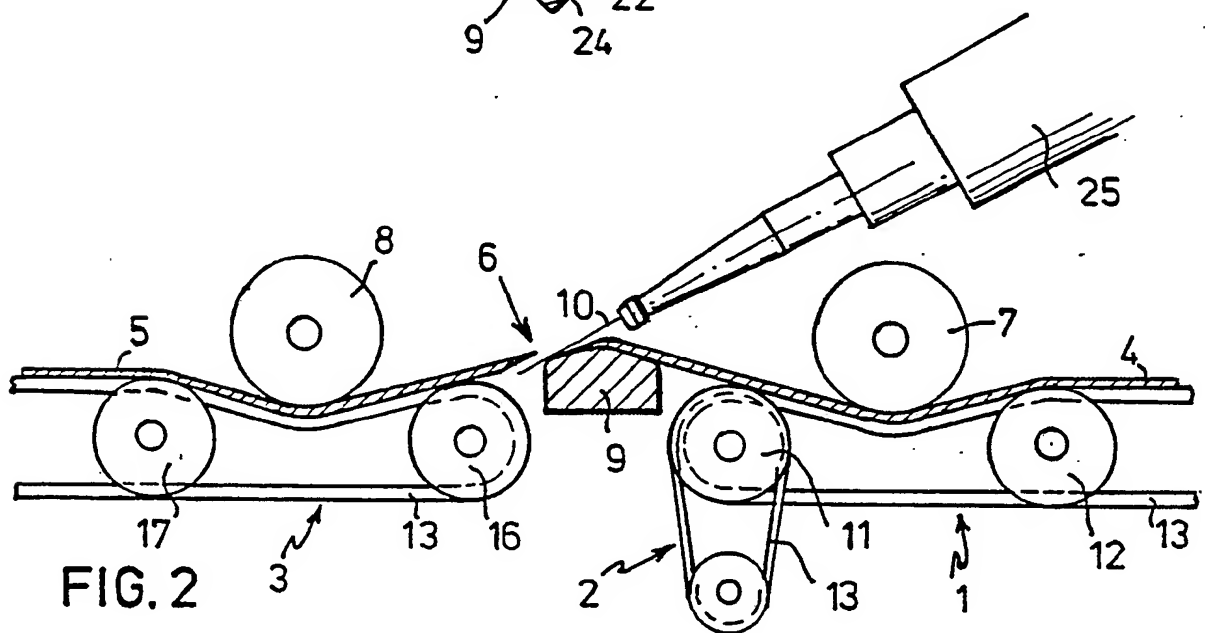
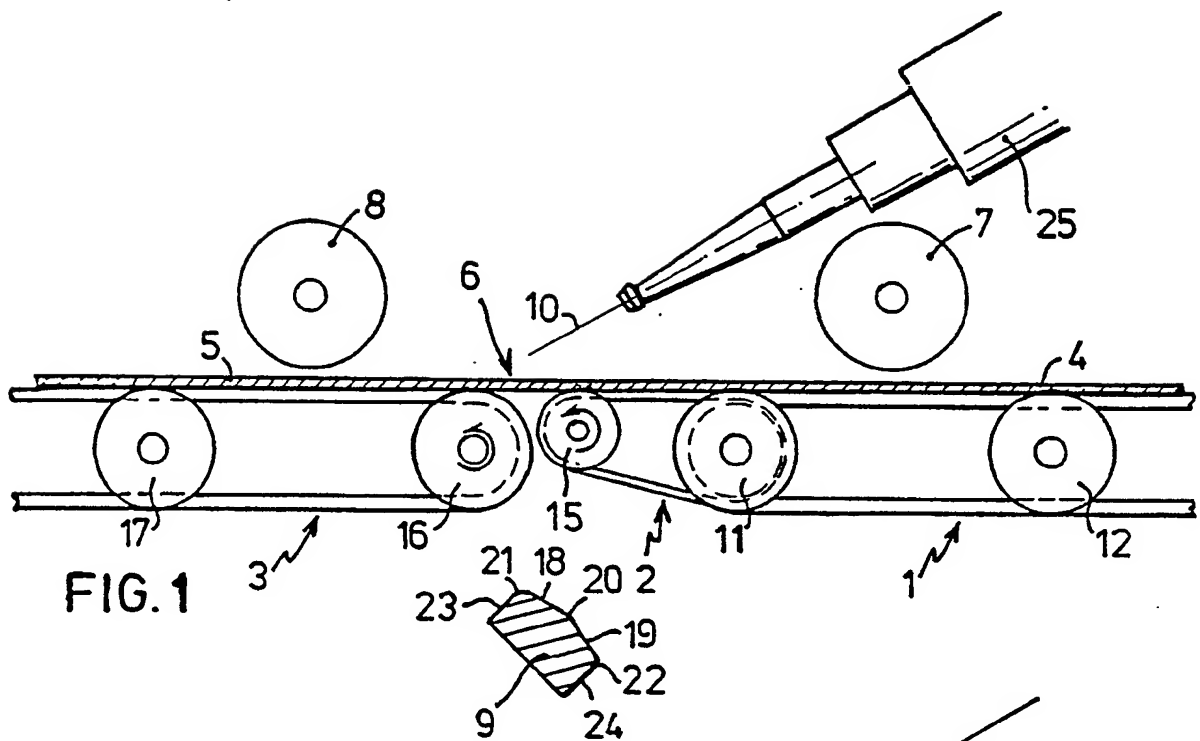
6. A cutting device according to claim 3 or 4, **characterized in that** the intermediate conveyor consists of endless strings running over two reversing rollers.

7. A cutting device according to any of the preceding claims, **characterized in that** each clamping member is a pressing roller.

8. A cutting device according to any of the preceding claims, **characterized in that** the upper side of the cutting beam is formed such, that cutting angles between 10 and 90 degrees can be realised when adjusting the angle of inclination of said knife.

9. A cutting device according to claim 8, **characterized in that** in cross section the upper side of the cutting beam substantially consists of two sloping surfaces, which join each other by a cross sectionally rounded off surface and which each join a side wall by a cross sectionally rounded off surface.

10. A cutting device according to any of the preceding claims, **characterized in that** when the cutting beam is situated in the high position, the knife with the blade bears on the cutting beam, whereas the point of the knife is spaced from said cutting beam and the knife extends cantilevered from the knife holder.



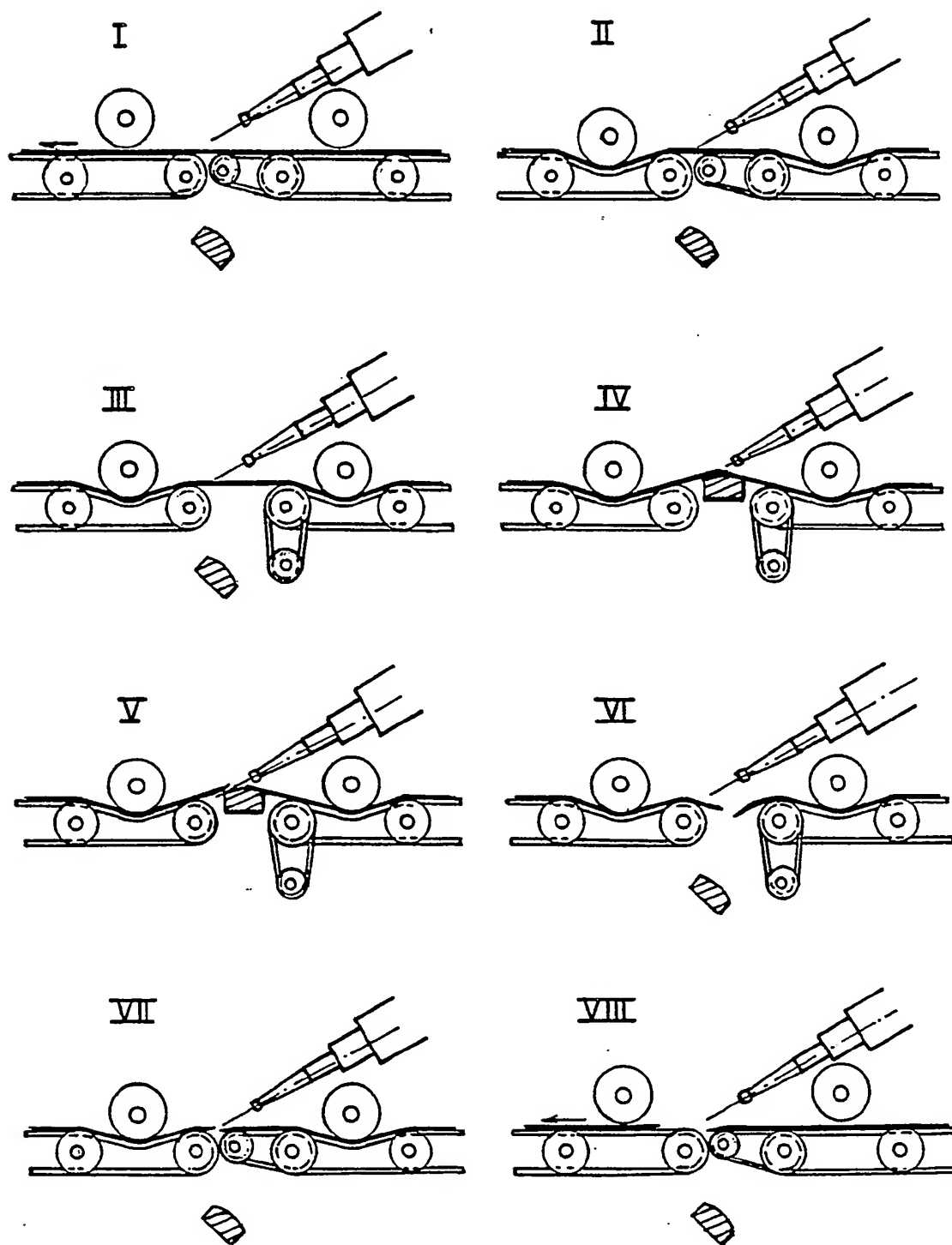


FIG. 3

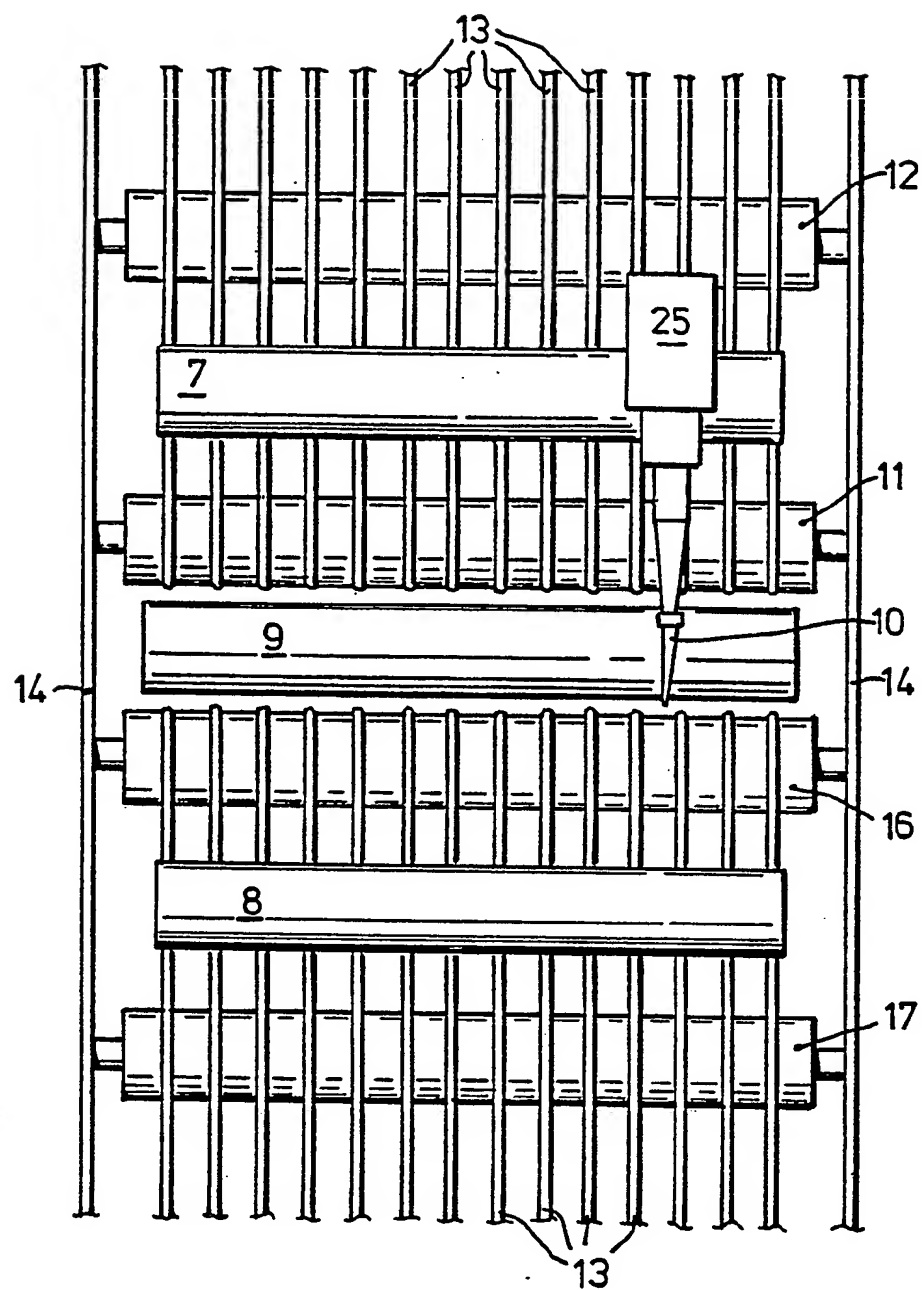


FIG. 4





DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
X	US-A-3 737 361 (E.G. OBEDA) ---	1	B 29 D 30/46 B 26 D 7/08
X	GB-A-2 178 686 (R. SAUNDERS) ---	1	
X	GB-A-2 087 290 (GERBER GARMENT TECHNOLOGY, INC.) ---	1	
A	DE-A-2 805 870 (METZELER KAUTSCHUK AG) ---	2,3	
A	US-A-2 948 177 (B. ARVIDSON) ---	2	
A	EP-A-0 105 748 (WM. STEWART) ---	2	
A	DE-A-2 638 884 (CONTINENTAL GUMMI-WERKE AG) -----	3	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			B 29 D B 26 D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 08-03-1989	Examiner DECLERCK J.T.
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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